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DON'T HURRY THROUGH THE PARK

TRAILSIDE NOTES

FOR THE MOTORIST
and
HIKER

Number One
MAMMOTH TO OLD FAITHFUL

YELLOWSTONE NATIONAL PARK

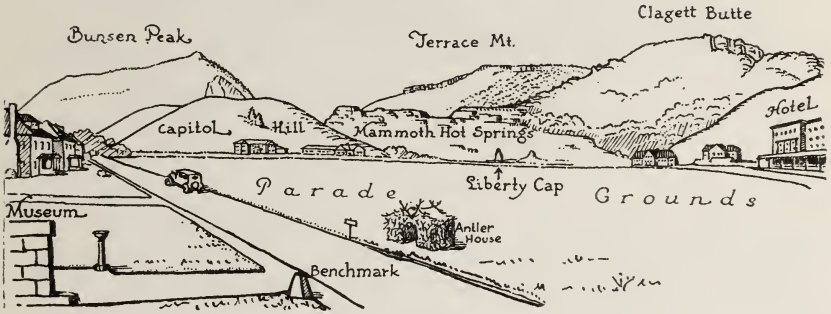
U. S. DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
1935

For the profitable enjoyment of Yellowstone the visitor should note the following:

1. Many times this part of the continent has been submerged.
2. During submergence layers of sediment gathered on the floor of the ocean—certain of these layers became hardened into rock.
3. After long ages these rocks slowly emerged and finally rose high above the sea level. Their folded layers we call the Rocky Mountain System.
4. During and since their period of elevation, volcanic activity and erosion have taken turns in modeling the landscape as we see it about us.
5. Terrific explosions have thrown out great quantities of volcanic material, (Tuff, Agglomerate, Breccia, etc.) and out of cracks and fissures molten rock has repeatedly flowed over the surface and even penetrated between the layers above mentioned and hardened into solid rock (Basalt, Rhyolite, Dacite, etc.).
6. The deeper masses of rock are still hot.
7. More recently, ice—in places several hundred feet in thickness—covered the entire area. Glaciers moved down the valleys, widened the walls and on melting left many evidences of their craftsmanship.
8. Hot water and gases rising from the—at first molten and then cooling—material on reaching the surface, gave up and are still giving up the substances held in solution, depositing them around their respective vents and thus forming terraces, cones, etc.
9. Throughout the processes above enumerated water and other agencies have been industrious and still are industrious in eroding the surface and in producing the landscape as it is today.

Trailside Notes

I. Mammoth to Norris



We meet at the Museum at Mammoth. We note that the "Bench Mark" shows an altitude of 6,239 feet. We identify the surrounding mountains—particularly Terrace Mountain and Mount Everts. We set our mileage at zero and drive to Liberty Cap.

MILEAGE MILEAGE

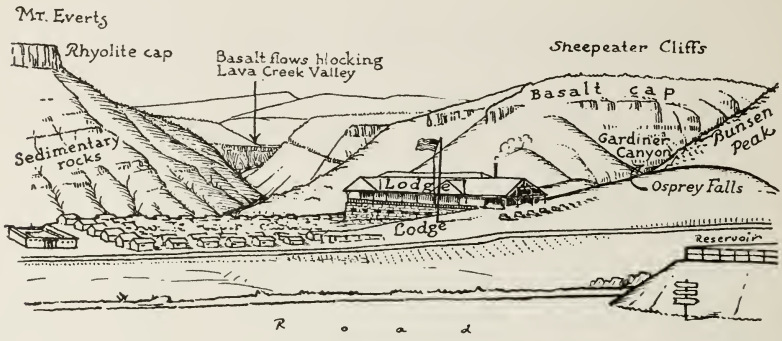
LIBERTY CAP (*At the right*) 0.4

The curved layers and an opening in the top indicate that this was once the nozzle of a hot spring. Compare with Devils Thumb, located a little farther away. The Hot Spring Terraces are made of travertine which is largely composed of lime.

0.4 (*At the left*) CAPITOL HILL

A huge mass of glacial gravel resting upon the terrace material, or travertine.

NOTE. The text is arranged in three columns. Objects on the tourists' right are described on the right-hand side of the page; those on the tourists' left, on the left-hand side. Objects in front and general descriptions occupy the middle of the page.



0.6 MOUNT EVERTS

Gives the horizontal sky line. Mammoth Lodge and its 300 cabins. Beautiful view up valley of Gardiner River and Lava Creek—Note winding road to Tower Falls.

0.9

Opposite the Lodge is Jupiter Terrace, richly colored by Algae.

Bunsen Peak (directly in front) is a huge mass of lava, and was named for the inventor of the Bunsen Lamp. Bunsen's theory of geyser activity is generally accepted.

1.3

We are climbing out of the valley of the Gardiner River.

2.0

Stop at Parking Area.

In the foreground take in the wonderful view of Jupiter Terrace. Sheep Mountain is in the distance at the north, and Sepulcher Mountain at the northwest. On our right is Mount Everts.

2.1

We pass the entrance to Formations Road leading to Devils Kitchen, Stygian Caves, etc.

2.3

Bunsen Peak covered with Lodgepole pine. Note how fire destroyed large tracts at the left. This occurred in 1883. A new growth is now appearing.

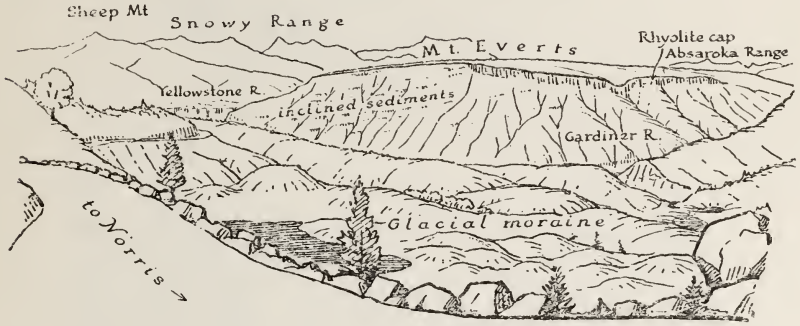
UFB

2.8 TRAIL TO SNOW PASS CROSSING GALLATIN MOUNTAINS 2.8

We now pass through a growth of Aspens. These trees are related to the Cottonwood and Poplar. The bark is a favorite food of the beaver and elk.

3.*

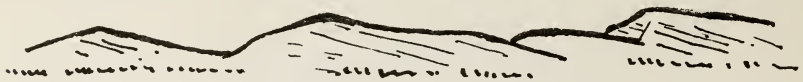
A nearer view of Bunsen Peak shows that it is scored by landslides. In the distance far to the east are seen the rounded peaks of the Washburn Group.



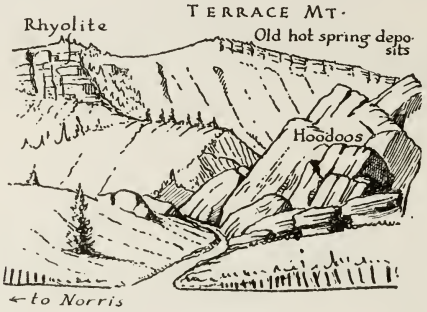
3.5 3.5

Stop at Siding. Spring of cool water. At right a bank of coarse gravel. At left the entire floor of the valley is covered with stones and other material as though it had been a dumping ground. The small ponds are surrounded by hills of gravel. To the north Sheep Mountain and other peaks of the Snowy Range. Look way across the valley at Mount Everts and note the oblique lines or strata. These indicate the layers of sediment which formed on the bottom of an arm of the ocean when this part of the country was submerged. At that time there were no birds or mammals, like those of today, and, of course, no human beings. Much later came flows of lava. One of these can be seen as a thin cap over the southern end (right) of the mountain.

Due to changes in the road, distances as given are only approximately correct. Government markers by the roadside give more exact distances.



On the horizon, at the left of Bunsen, the peaks of the Washburn Group again appear as rounded hills.



4.0 SILVER GATE AND THE HOODOOS 4.0

Approaching Silver Gate we are abruptly confronted with a picturesque mass of huge blocks of stone. What they are and why they are here will presently appear. The charred trunks are the ghost of a forest destroyed by fire. Young trees are beginning to spring up.

4.4 THE RHYO-TRAVERTINE GULCH 4.4
ROADSIDE EXHIBIT

We park and dismount. The gulch leads up toward the crest of Terrace Mountain. There is much to be seen at this parking place.

1. Looking up the gulch one notes that most of the rocks on the right are whitish, angular and many seem to be in slabs or layers.
2. We trace them to the top of Terrace Mountain where they form a distinct layer.
3. We examine them more carefully and find that they resemble the limy deposit of the hot springs. They and the Hoodoos are hardened travertine.

4. We are driven to conclude that at some remote time hot springs were active on the crest of this mountain and that their limy deposits covered a wide area to a considerable depth. The springs at Mammoth are a mere remnant of a display that extended from the crest above to the valley of the Gardiner River far below.
5. See how the travertine crust rests upon brownish rocks that have a very different appearance. These are of rhyolite—the same kind of volcanic rock that crowns Mount Everts.
6. It dawns upon us that at one time the entire valley out of which we have been climbing was filled—at least to the height of Mount Everts—and that over this plateau there flowed a layer or layers of molten rock. On cooling this lava hardened into the brownish rhyolite which lies before us. Then followed certain periods of erosion, after which the hot springs deposited their successive layers of travertine.
7. Turning to the left side of the gulch we find that most of the rocks are brownish rather than white. They are in rounded masses rather than in layers. They contain small cavities, and if we examine the rocks more closely we find that they are heavy and have small glistening crystals.
8. We conclude that these rocks were once molten lava—heavy with mineral matter —the small cavities were made by bubbles of gas—crystals were formed during the process of cooling. The gulch marks the dividing line between masses of water-produced travertine and heat-produced rhyolite.

But why is this dividing line? Why the Hoodoos through which we have passed, and why

the boulders of rhyolite which we are now meeting?

> A glacier did the mischief. There is evidence that ice and snow covered this entire region to a depth of hundreds of feet, and as it slowly slipped and flowed down the valleys it carried boulders, rocks and gravel in its embrace or shoved them along in huge masses. (There are rivers of rushing water under glaciers.)

Here, near their origin, the travertine blocks and the rhyolite boulders have not begun to mingle, but as the ice rolled them over and over down the valley they became mixed up and finally—on the melting of the ice—they formed the hillocks of coarse gravel and boulders that we have seen in the valley on our way up from Mammoth.

Bunsen Peak

The configuration of this mass of volcanic rock and its composition (dacite rather than rhyolite) are evidences that it was intruded in a semi-molten state from hot layers of the earth's crust. From the fact that when we ascend the canyon we will find that the layers of rhyolite apparently flowed *against* its flanks it is evident that Bunsen Peak must have been well established before—if not long before—the period of rhyolite activity.

While here in the gulch let us review the sequence of geological events.

1. Bunsen Peak was intruded as a stock.
2. Rhyolite flowed against its flank and across the valley.
3. The landscape of rhyolite was being eroded.
4. Hot springs brought up lime from the deep-lying rocks and began to deposit it—as travertine—upon the upper layers of rhyolite.

5. Glaciers of the Ice Age—twenty or thirty thousand years ago—tore off and transported both travertine and rhyolite.
6. Hot springs continued to deposit travertine—they were not extinguished by the ice.
7. Present-day vegetation and climatic agencies are wearing away the picturesque landscape in a tireless effort to reduce everything to a level of uniformity.

We enter and ascend Golden Gate Canyon and in doing so pass upward through the thick layers of rhyolite already observed. We are literally walled in by them. From the varying colors and structure of these frowning walls we conclude that they result from several distinct volcanic flows.

5.1 5.1

We pass through Golden Gate—so named because of the brilliant yellow of an encrusting lichen (one of the lower plants) and emerge on Swan Lake Flat.

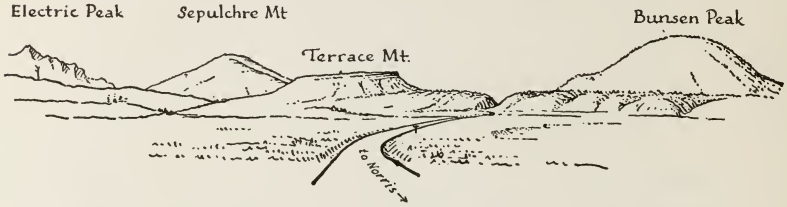
At the left is a road around Bunsen Peak. (A fascinating drive down the Gardiner River —the canyon of which is lined with lava that has cooled into a marvelous series of columns— past Osprey Falls and back to Mammoth.)

We have climbed a thousand feet since leaving Mammoth and are nearly a mile and a half above sea level. Before us stretches the "Great Rhyolite Plateau" and on this plateau we will generally remain while following the "loop roads" around the park.

6.2 SWAN LAKE PANORAMA 6.2

We stop and take in a wonderful panorama. Swan Lake Flat was once the bottom of a large lake, surrounded by banks, terraces and hillocks. The hills are largely composed of the same kind of glacial debris that made Capitol Hill, and was seen covering the valley of

Gardiner River. The glacier which arose on the mountains at the west (Gallatin) was of relatively late occurrence and must have been a big one.



The surrounding mountain peaks are as follows: At the rear, (N.E.) Bunsen, at the left of which is the light gray crust of Terrace Mountain. Farther removed is the rounded, partially wooded, Sepulcher Mountain, and still farther the jagged Electric Peak, hardened by many igneous intrusions. A small cap of rhyolite on the top of Bunsen Peak suggests that rhyolite flows may have reached as high as its summit. To the southwest are four apparently united peaks. The one at the left is Trilobite Point, so-called because trilobites—fossils of crustacean-like animals—have been found in the rocks of this mountain. The second is named for an eminent scientist, who gave the first geological description of the park, Dr. W. H. Holmes. On its summit a small "lookout" can be seen. The remaining two peaks in this group form Dome Mountain. Further to the right, Antler Peak stands quite alone. The long ridge extending from Antler toward Electric is Quadrant Mountain. The peaks from Trilobite to Electric mark the crest of the Gallatin Range. Ten miles to the west of this range is the Gallatin Highway.

Toward the east—on the distant skyline and south of Bunsen Peak—are a series of elevations that mark the location of the Washburn Group, at one time thought to mark the rim of

a volcano—"Mount Sherman." Mount Washburn, Tower Falls and Camp Roosevelt lie beyond this ridge.

Swan Lake is all that is left of a large lake that once covered this level area—Yes, swans used to live here, but they and certain other birds and mammals are now less frequently seen. You may walk to the lake, and if fortunate you may see wild ducks, and perhaps delightful little phalaropes swimming about like miniature swans.

If you wish to know the names of birds,flowers, trees, etc., you should visit the Trailside Museums and Field Exhibits located at various points on the "loop."

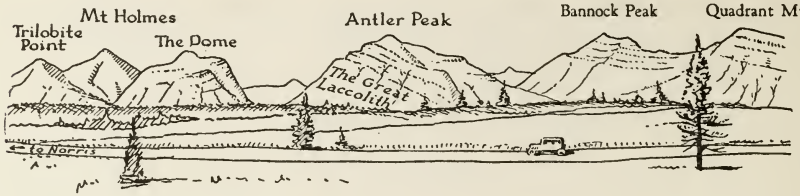
7.9 7.9

Proceed slowly. The middle distance is covered by Lodgepole pines. In the foreground are low hillocks and ridges of glacial gravel and volcanic rock.

There is an exposure of basalt on the extreme right. It shows that this dark, heavy lava at one time flowed out upon the rhyolite plateau on which we are riding.

8.2

Here we get our best view of the peaks of the Gallatin Range. Notice how abruptly they rise like islands out of a sea. They are old mountains partially engulfed in lava flows. The parallel bands or strata on the mountains of the Gallatin Range recall those on Mt. Everts. They are significant. The strata are not volcanic, they are sedimentary. They contain fossils of marine animals and therefore, they must have formed on the bottom of some ancient sea or seas.



Geologists tell us that the entire area that we now call the Rocky Mountains was the bed or beds of shallow seas and as the sedimentary layers were lifted, they emerged from the ocean and the eroded remains, which lie before us, now are eight or nine thousand feet above the present sea level.

During this process the horizontal layers have been tilted, folded and cracked. Volcanic rocks have been intruded. Crests and peaks have been worn away, valleys have been formed and molten lava has repeatedly flowed up from below covering the surface as we have already seen.

8.4

A road leads to the Basaltic Amphitheatre, one-fourth mile away, and well worth a visit.

8.6

We note the junction of Obsidian Creek, and the Gardiner River. The latter conveys the melted snow from the Gallatin Mountains and adjacent foothills. From this point it is quite evident that Quadrant Mountain is composed of stratified rocks.

9.0

We follow Obsidian Creek and enter Willow Park. Stunted willows cover the valley. Remember that we are in a high altitude, the winters are long and cold. Certain trees cannot live here. Look sharp for moose.

THE BEAVER DAM FIELD EXHIBIT 11.3

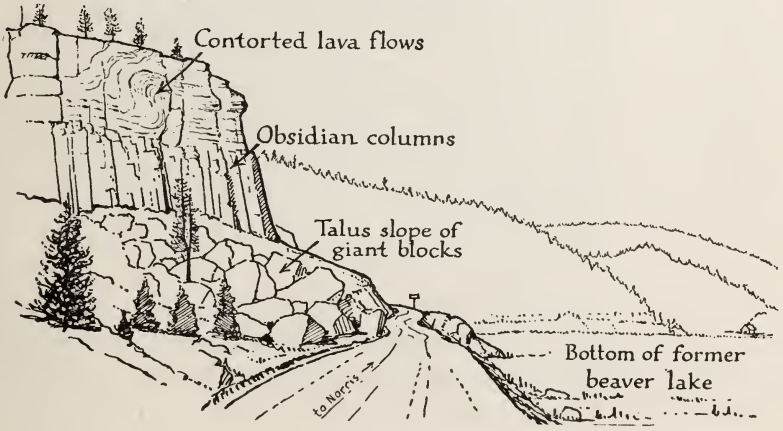
We park and dismount. Mount Holmes—crowned by a small lookout station—rises in the west. Trilobite Point extends towards us. To the right is Dome. Immediately in front of us several beaver dams arrest the flow of Obsidian Creek. Sediment is consequently deposited. Vegetation takes root and fertile soil results. Through this the river meanders. Thus the beaver has much to do with the formation of arable land. Look back toward Sepulcher Mountain and see the extent of the meadow-like area.

11.9 APOLLINARIS SPRING

Dismount and sample the water. The spring is well-named. As we proceed be sure to note the black, glassy boulders by the roadside and in the gravel pits. They are evidence that we are approaching Obsidian Cliff.

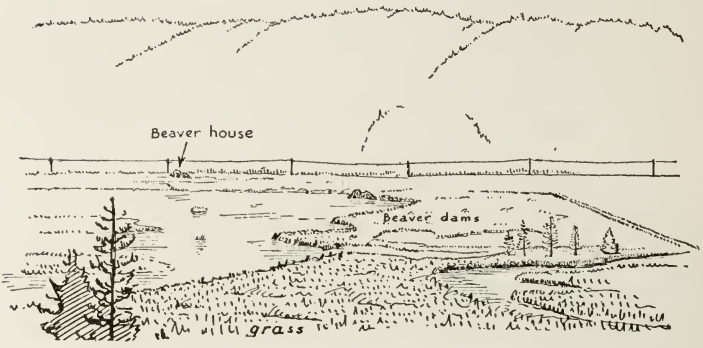
12.4

Go slow as you pass Yellow Lily Pond. Possibly ducks and perhaps deer in the willows. The valley closes in and we pass through a grove of beautiful Engelmann spruce. How different they are from Lodgepole pines.



THE OBSIDIAN CLIFF FIELD EXHIBIT 13.3

Park, read the labels and get the story.
We are still ascending Obsidian Creek and before us opens another broad valley, the result of the work of beavers. Sedges, here, rather than willows.

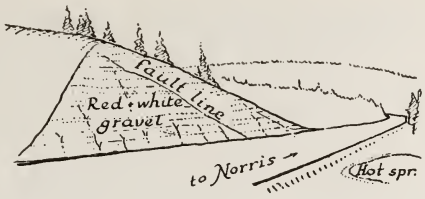


ANOTHER BEAVER DAM 13.4

Look across the pond and see the "beaver house," near one of the telephone poles. Wild ducks breed here. On the left of the road is a mass of rhyolite. In places, obsidian passes imperceptibly into rhyolite.
As we proceed, we note that there are no obsidian boulders along the roadside and we conclude that when the glacier picked up material from Obsidian Cliff it was flowing northerly rather than in the direction we are going. It is by such evidence that the geologist reads the "Book of Nature."

15.4

Obsidian Creek is growing smaller. Highways often follow water courses because water finds and follows the low grades. Note the profusion of flowers.



16.5

The Geologist reads this gravel bank as follows—

1. At the close of the Ice Age the valley of Obsidian Creek was a lake.
2. A stream from the uplands flowed into this lake.
3. At first the stream brought fine sediment which was deposited as clay, and now forms the base of the bank. If you examine the clay carefully you will find that it was deposited in layers.
4. On top of the clay is a brownish band of fine gravel. Something must have happened upstream. It looks as though hot springs had broken out somewhere and iron and sulphur had solidified and stained the gravel.

16.6

5. Since "the more rapid the flow the larger the pebbles" we conclude that the streams emptying into the lake must have had varying velocities.
6. The colored (red) bank a little farther on gives positive proof that—after rivers deposit sand and gravel—hot springs, bearing iron and other coloring matter, may come into existence. The oblique line is evidence that underlying strata have moved a little and made a "fault line"—that a miniature earthquake occurred.
7. Semi-Centennial Geyser proves that violent hot spring activity may be of short duration. During the celebration of the

fiftieth anniversay of the founding of the Park, there was a violent explosion at this point. Rocks and boiling water were blown to a height of three hundred feet, traffic was stopped and thermal activity took part in the general program.

8. We conclude that hot chemical vapors are active agents in disintegrating rhyolite. Remember this when you marvel at the depth of the canyon of the Yellowstone.
9. See how the disintegrated and dissolved rhyolite gathers into small heaps.
10. When it rains, this powdered rhyolite is carried off by the small streams. It starts on its long journey to the ocean.
11. In the ocean it settles down as sediment and thus nature transforms an igneous rock into one that is sedimentary.

Notice how several little meadows have been made by this small stream. It has been assisted, of course, by the rain and snow that have brought dirt down from the side hills. Steam rises from several places.

16.9

Here we leave Obsidian Creek, the waters of which finally reach the Yellowstone at Gardiner.

17.0 Roaring Mountain

The story—and an interesting one—is told on the marker.

Twin Lakes 17.5

The first, nine feet or more above the second, is deep olive green. The second is of a different shade. The lakes are apparently being kept apart by an old beaver dam upon which trees are now growing, the interlacing roots of which preserve the original structure. These lakes drain into the Gibbon rather than into the Yellowstone. We have, therefore, crossed what is called a "divide."

19.3 Nymph Lake Field Exhibit 19.3

This is a most instructive spot.

1. At the left is an outcrop of our old friend —the rhyolite.
2. Through its cracks and crevices hot decomposing gases have arisen from below destroying its character and changing it into mineral substances of various texture and color.
3. The action is still going on. Look up at the left and see the steam and fumes.
4. As you climb the hillock, the soil becomes hot and around the vents you will find that, as the vapors cool, sulphur in fine, yellow crystals is being deposited. (Don't disturb, others too may want to see).
5. Below us, on the right of the road, vapors are also rising. There is a boiling pool.
6. Some of the water in Nymph Lake doubtless filters down onto the hot underlying rocks and comes back superheated.
7. Nearby is the "Tap" of scalding water. It flows down into the "Tub"—reminiscent of Monday both in color and temperature.

The Frying Pan 19.5

Don't be fooled. It is not boiling, plants are growing around the edges. The bubbles are made by escaping gases.

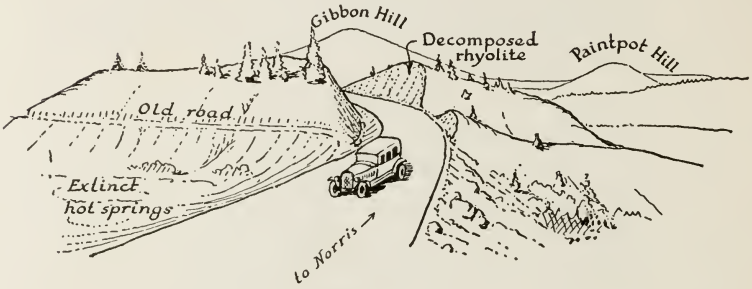
19.8

More rhyolite. Altered at the far end as it approaches hot springs and steam vents.

As we proceed we see more hot springs and the earth by the roadside is warm, vaporous and discolored.

20.2 20.2

Lodgepoles as far as you can see—millions of them. On the horizon at the left rise the low mountains that we noted as comprising the Washburn Group.

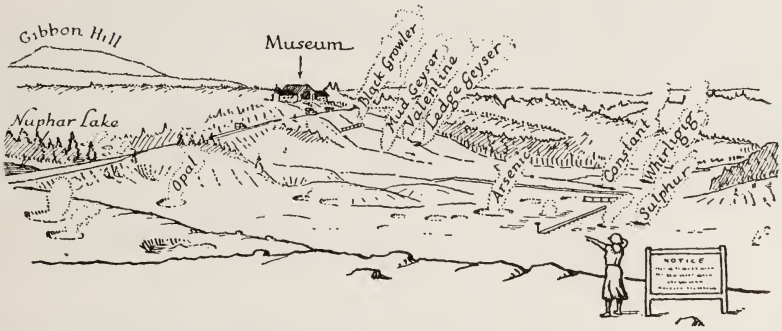


20.5 20.5

The road now passes through a highly colored, whitish formation. Can it be that these hills are composed of mineral matter like Terrace Mountain that has been brought up from below by superheated water and steam? No. If we study this formation we find that the whitish banks along the roadside were originally composed of rhyolite, such as we have recently seen, but they have been decomposed into gravel and sand. Vapors of sulphur, and other gases have bleached the original darker lava and solutions of iron oxide and iron hydroxide have stained it yellow, red and pink.

21.3 NORRIS RANGER STATION AND AUTO CAMP 21.3

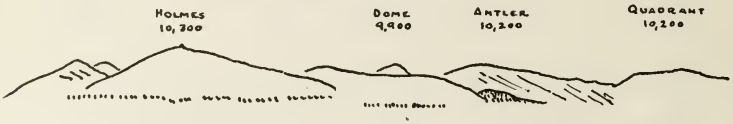
Here, at a concrete bridge, we meet the Gibbon River down the valley of which we will presently go until at Madison Junction it joins the Firehole River, and thus forms the Madison. The Madison empties into the Missouri at Three Forks, Montana. (The water travels more than four thousand miles before reaching the ocean at New Orleans). Look around for elk.



22.1 22.1

We bear to the right and suddenly come out on the rim of Norris Geyser Basin—"Nature's Laboratory."

Here, through the agency of hot water, steam and other vapors, quartz and other mineral matter is being brought to the surface from below and deposited as "sinter." Not only are the exposed hills of rhyolite being decomposed but the underlying rocks are yielding in this "chemical warfare."



In the distance we again identify the mountains of the Gallatin Range. The profile from this angle is quite different from that heretofore seen. The lookout station identifies Holmes. The diagonal strata identify Antler and Quadrant. The dark area under the strata of Antler is a huge mass of once molten rock which was forced out of the earth, actually lifting the mountain and tilting it out of level.

Nuphar, a cool lake, considerably above the level of the basin. Why does it not drain into the basin?

We pass steaming vents and violent jets of scalding water.

22.3 THE NORRIS TRAILSIDE MUSEUM 22.3

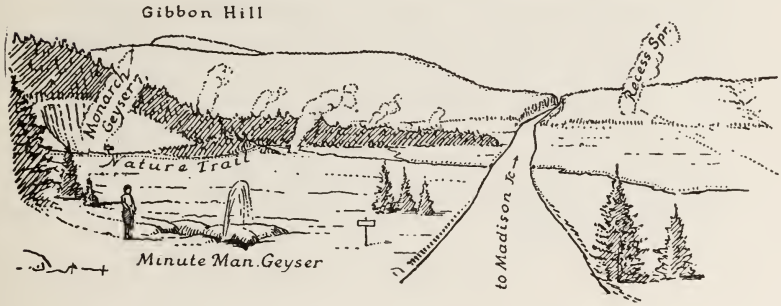
You will add to the profit of your visit by spending some time examining the exhibits, reading the labels, referring to the relief map and conversing with the Ranger Naturalist. A half hour, selfguiding nature trail starts from the rear of the museum. It provides many interesting sights.

II. Norris to Madison

Having visited the Trailside Museum at Norris we set the mileage at zero and continue our journey down the valley of the Gibbon.

0.3 0.3

Presently we enter Echinus Basin (Echinus is Greek for spine). In this area the hot waters seem inclined to cover everything in their neighborhood with spines. If you dismount, be careful. The crust is thin in places.



Minute Man Geyser does not always live up to the reputation of its colonial namesake. Monarch has abdicated and trees are beginning to grow on the walls of its crater.

0.8

Don't miss the green deposit around Copper Cauldron or the red deposit around Ferric Cauldron.

Elk Park

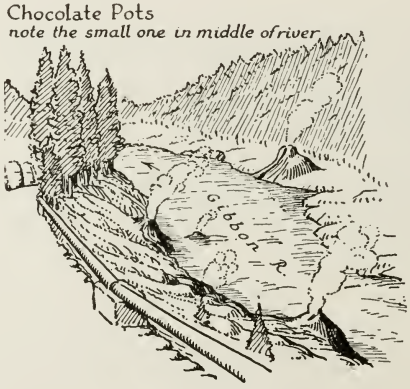
The encircling hills are largely the remains of lava flows. This is one of a series of beautiful meadows—a filled lake bed—through which the Gibbon River leisurely meanders. In the early morning and late evening deer and elk may be seen.

1.2 1.2
Mount Holmes rises majestically above the plateau. To the extreme right a bit of Electric Peak pierces the horizon.

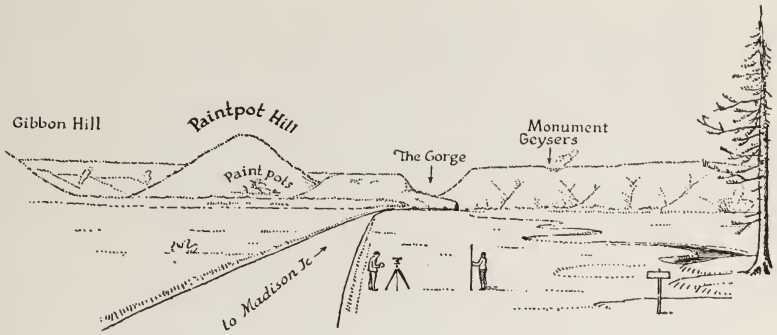
1.7 1.7
We enter a dense stand of Lodgepole pines.

2.3 2.3
At the Gibbon Cascades we stop at the turnout and dismount. The rhyolite at the left has a purple shade. At one time it doubtless extended as a dam to the other side of the river. The acidic waters often undercut the boulders making what are called "duck rocks." Walk back a bit and note that these undercut rocks are on the higher banks on both sides of the river. This is evidence that the river, not so very long ago, was much higher than it is at present. The cascades are tumbling over horizontal layers of rhyolite in their work of lowering the channel.

Chocolate Pots
note the small one in middle of river



2.4
Drive ahead to the Chocolate Pots. Note—100 feet down stream—a miniature geyser forcing its jet up through the river.



2.9 GIBBON MEADOWS 2.9

Black patches of rock on the encircling hills, rising steam, and the walls of the gorge that we are about to enter argue that we are still surrounded by and are motoring on and through huge masses of volcanic rock that have invaded Yellowstone from some unknown source. This is the largest of the filled-in lake beds which we shall meet while motoring down the Valley of the Gibbon.

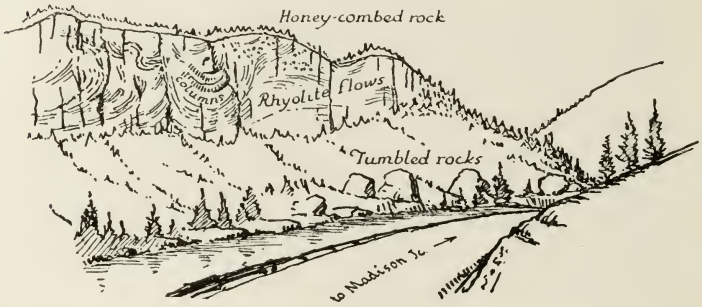
Monument Geyser is probably steaming away on the top of the elevation at the right. Why did it not find a vent at a lower level? Another fine view of Mount Homes.

3.6

At the foot of Paintpot Hill—about one-half mile from the road—are a series of hot springs and pools having most brilliant colors—the brightest in the Park.

4.0 4.0

Leaving the meadows, we enter Gibbon Canyon. We dismount at the little rustic bridge. The frowning walls at the left recall those that we saw at Obsidian Cliff, but on closer examination of the boulders we find a greater variety of structure. The molten lava that flowed down this valley must have come from a different source, contained a different ratio of elements, had a different rate of cooling, and the flow probably occurred at a different time. If we do not attempt Monument Geyser we proceed down the gorge.



4.3

Note the flowing lines assumed by the lava as it cooled.

4.4

Thermal activity is evident at Iron Bridge. Lodgepole pines seem to enjoy growing out of rocks in a most impossible way. A lot of geological events have taken place here.

4.8

We stop at Beryl Spring—an agitated cauldron. Sulphurous steam rises from the vent. The rock in the cut just beyond the spring is an agglomerate.

5.2

Look up at the left wall of the gorge and imagine the hot viscous, lava creeping slowly down.

The white rock, just above the river, looks like travertine or sinter. We wonder if it marks a hot spring.

5.5

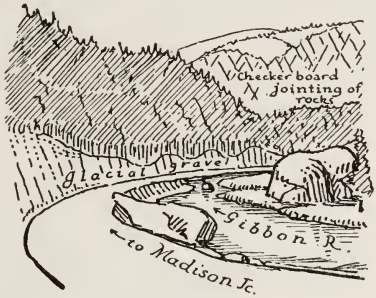
More white rock. Hot water is certainly extracting something from below and depositing it on the surface.

At one time a mass of debris was being forced into the valley at this point. Note the variety of rocks in the exposed bank.

5.9

We approach an iron bridge and face a grand buttress of pinkish rhyolite.

Coarse glacial debris on this side.



6.5

Before crossing the cement bridge note, high on the right, the cross-seaming and checkerboard cracks in a majestic cliff—a part of Purple Mountain. Along the flank of this mountain we will motor for several miles.

See how one mass of rock has slid over another and smoothed its surface.

7.5

Further evidences of the glaciers' craftsmanship.

7.8

Splendid "annual layers" being destroyed by percolating water. A lake must have been here. The successive layers of clay represent successive years of deposit in the bottom of a glacial lake.

7.9

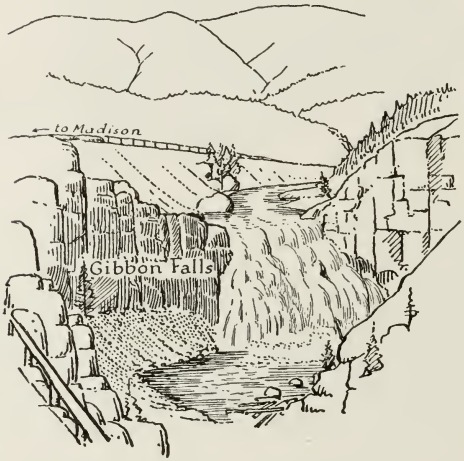
More "annual layers" and hence more evidence of a lake or pond.

This exposure is said to be one of the best in the country. It is estimated, by counting the several layers, that there are at least a thousand years here recorded.

A splendid cross-section of a river bottom. It evidently cut right through an earlier lake bottom. It shows minor faults or slips.

A brook comes in from the right.

We face a wall of firm rhyolite. Blasting has removed the older face of this wall. Compare the new artificially exposed surface with the older natural exposure at the right. We pass another mass of glacial rubble.



8.2 GIBBON FALLS

We dismount. This is where the river drops eighty feet from one layer of lava rock to another. From what we have just seen, and from the appearance of the banks, the work of a glacier and its underlying mud and boulders are strikingly exhibited.

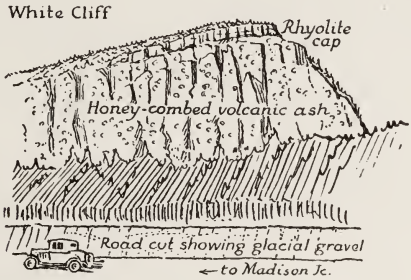
The boulders attain amazing proportions.

For half a mile we pass along a great variety of river and glacial deposits. All these have one thing in common, viz. a great variety in size, composition, and bedding of material from the heaviest boulders to the finest clay.

9.3—10.6

We pass more exposures of the rhyolite of Purple Mountain.

We pass through an avenue of Lodgepole pines. National Park Mountain looms ahead.

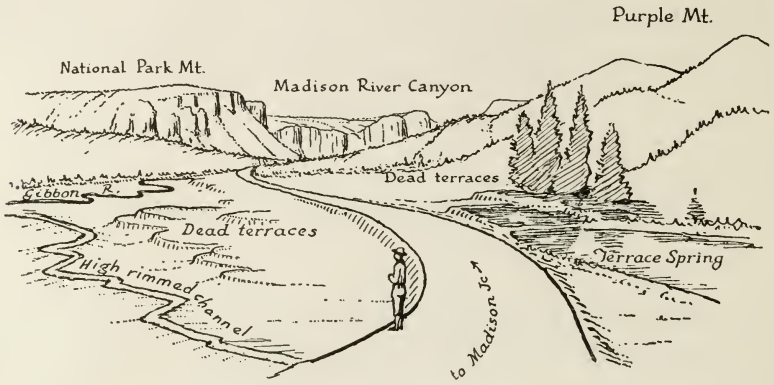


TUFF CLIFF FIELD EXHIBIT 11.8

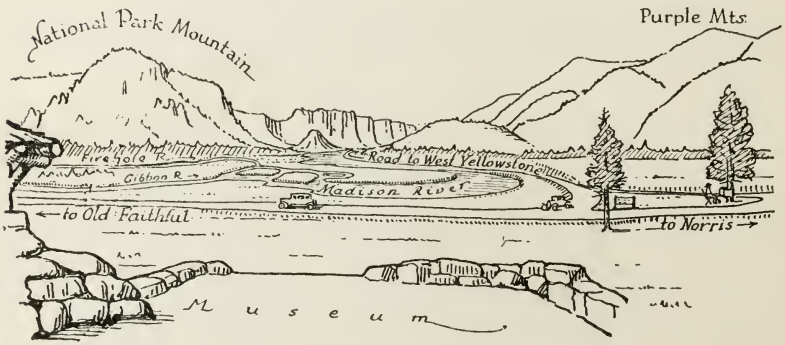
Dismount and follow trail to base of "Honey-Combed" Cliff

The tuff or volcanic ash is a very soft, friable rock. In many places it has been weathered out leaving holes and gullies. The cliff would have been washed away entirely if not protected by a cap of rhyolite. Test the relative weight of tuff and rhyolite. The first descended from the air, the second ascended from below.

12.4
The Gibbon flows at our left—note the verdant meadows.



The road emerges from the forest and a beautiful scene is spread before us. Purple Mountain on the right with its series of peaks, the vertical wall of Madison Canyon in front, flanked on the left by National Park Mountain.
12.7 12.7
Terrace Spring on the right and left, cascades from one level to another like the hot springs at Mammoth. For some time the terraces at the left were dead, but a recent change in the course of the warm brook leading to them has vitalized them and they are now radiant with color. Both sinter and travertine are deposited.



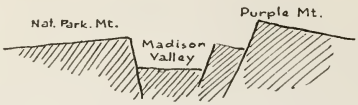
Trailside Museum

13.6 Madison Junction 13.6

We park in front of and visit the Trailside Museum at Madison Junction. Here we will find an interesting history of the paths taken by the early trappers and explorers and a full account of the work of the Washburn-Langford Expedition of 1870.

The scenery at Madison Junction should receive attention. It is also one of the best places to illustrate an important event in the geologic history of Yellowstone. After the flows of rhyolite had been poured out to a depth of hundreds of feet they did not remain horizontal sheets. The earth's crust broke into large blocks and—in tilting unequally—exposed steep cliffs at their edges. Rivers naturally sought these fractures. It is at the base of cliffs and other exposures that we have been winding our way. Madison Junction is thought to be the meeting place of fractures between three major blocks, the cracks having been widened by glaciers during the Ice Age.

If you examine the relief map in the Museum, you will see that one of these blocks lies in the angle between the Madison and the Gibbon Rivers. A second lies in the angle between the Madison and the Firehole, and the third is the eroded Central Plateau.



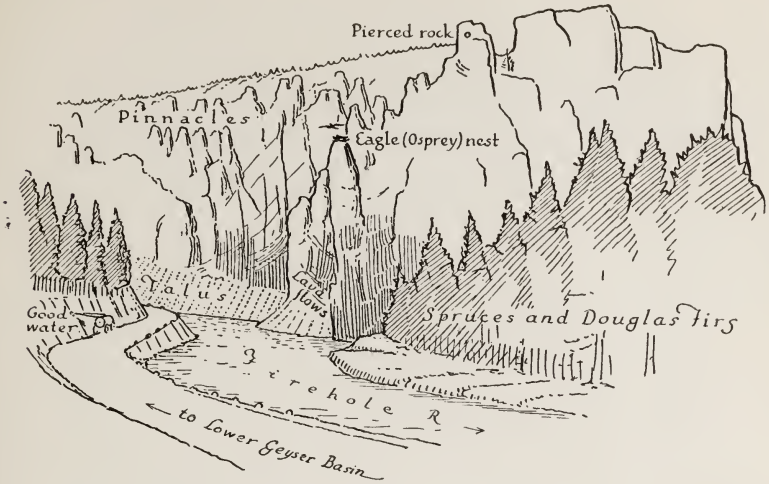
The Madison River flows in the crack between two huge blocks of the earth's crust.

III. Madison Junction to Old Faithful

Having visited the museum and enjoyed the view down the Madison Valley we set our mileage at zero, cross the concrete bridge and enter the Firehole River Gorge. We will drive slowly for the next two miles and observe the striking exposures of volcanic rock: Pinkish rhyolite, soft gray pumice, black, glassy obsidian, red and black perlite with glassy bubbles and breccia of cemented rock fragments, all interspersed with white, soft tuff. A magnificent wall of rock carved into pinnacles, rises before us. Alcoves in the wall result from the ease with which the perlite becomes weathered.

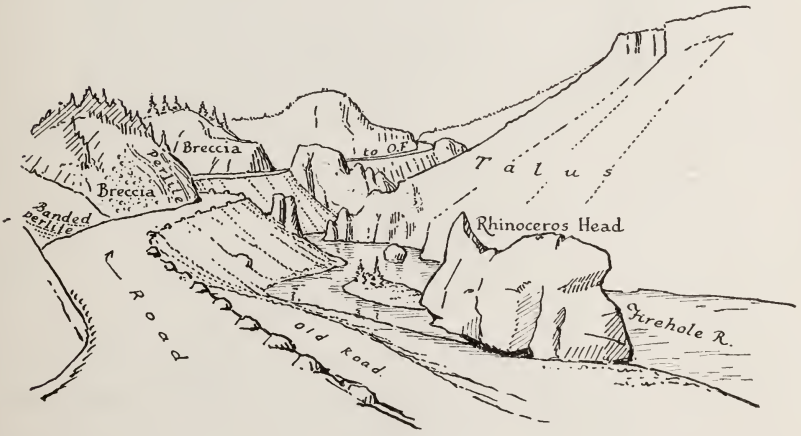
0.3 0.3

How different is the grim mass of volcanic rock on the right from the low exposures of rhyolite on the left! Can it be that we are looking at the face or side of what was once a glowing, viscous mass of molten rocks accompanied by intense heat and roaring with the crackling and crushing of its crust. It was a diabolical river of fire, slowly flowing from some unknown source.



0.5

We stop where a little stream trickles down over the rocks. Flowers abound. We dismount, identify the flowers, look up on the opposite side and discover an osprey's nest.

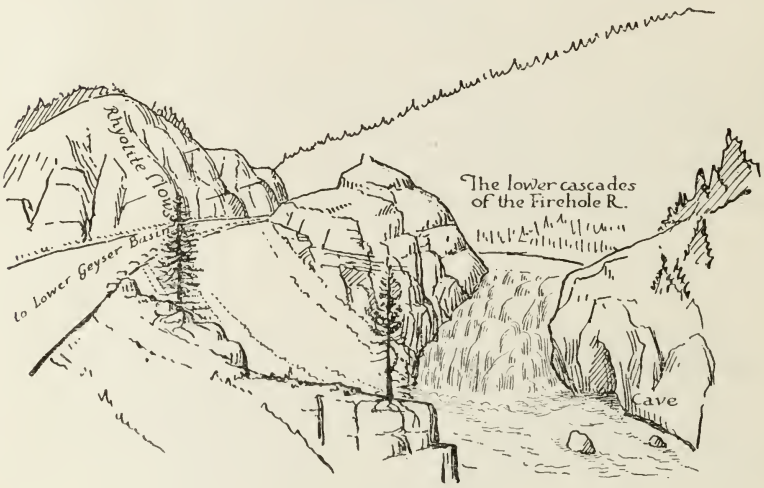


0.7

At the Rhinoceros Head we note that the volcanic mass has crossed the river to our side and as we look ahead we see that the road winds into it.

Firehole Canyon Field Exhibit

The artificial cutting of the road gives us a rare opportunity actually to look into the very substance of a congealed flow of lava. The angular fragments show that there must have been volcanic explosions of great violence and of long duration. This was not a silent performance. It was no place for tourists.
Note the large boulders and angular fragments imbedded in the lava and volcanic ash. Those boulders of obsidian prove that there were old rhyolitic flows long before the expulsion of this mass of volcanic rubbish



The Lower Cascades of The Firehole 1.0

The smooth surface of the rock at the left of and directly under the cascade is hard, horizontally-banded rhyolite. A huge mass of volcanic rubble seems to have flowed over this underlying rhyolite layer. The river finds it easy to cut through the coarse breccia but difficult to cut down through the hard rhyolite shelf. See how the softer breccia is undercut.

For the next half a mile the river passes through a narrow gorge with almost vertical walls. It is said to cut its gorge more rapidly than other rivers on account of the chemical content of the water coming down from the geyser basins.

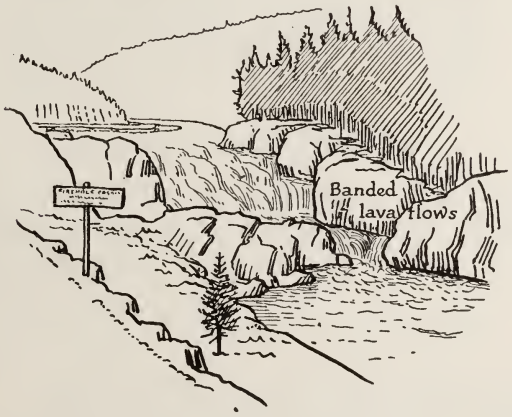
1.5 1.5

As we proceed, note again how the river has undercut the cliffs and made a series of caves along a line horizontal with its present level. It must have been flowing at about where it is a long time but cavities above the stream prove that it once flowed at a higher level. How different is the craftsmanship of cold water flowing over the surface of igneous rocks from that of hot water flowing out from them.

1.9 1.9

A little fertile valley—grass bordered. This is evidence that for a time there was a dam holding the water back and thus producing a small lake or pond.

Lodgepole pines do not need very much soil. Note those growing on isolated boulders.



THE UPPER CASCADES OF THE FIREHOLE 2.3

Here the layers of lava stand almost on edge. The rhyolite and perlite, interspersed with slag, are full of spherules, indicating that, when hot, there were a multitude of gas bubbles. The river is having a hard time cutting through this dam of rock. As we proceed let us see if a meadow has not resulted—Yes, it has.

Look back. Observe Purple Mountain. We are nearing the top of these lava flows.

2.7

A fragment of rock by the roadside shows that when it was molten it contained bubbles of hot gas as large as eggs. Concretions have been formed within these cavities.
Lodgepole pines still persist in growing out of rocks.

3.2

The level verdure-lined stretches along its banks, the undercut rocks, its even gradient, and the peaceful flow of the river argue that its bed is composed of horizontal strata of uniform hardness. The green stretches are miniature terraces.

5.7 THE LOWER GEYSER BASIN 5.7

Having climbed the Firehole we are now again at about the same level as when we were at Swan Lake Flat and at the Gibbon Meadows.

6.2 NEZ PERCE CREEK

The trail at the left leads through Nez Perce Valley to Mary's Lake and from there to the Hayden Valley on the Yellowstone River

above the Canyon. In this valley Chief Joseph, during his historic retreat, captured and subsequently released a party of visitors. This was in 1877, several years after the creation of the Park and before there was adequate supervision of the area.

The Lower Geyser Basin opens out before us. This is the largest geyser basin in the park. The Hayden Survey counted 680 geysers and hot springs in this basin.

8.1

Turn right at the "Paintpot" parking area and mount the hillock. Dismount and visit the extraordinary sights of thermal activity as indicated on several markers.

Before seeing the sights, however, let us orient ourselves. Looking back we pick up our old landmark, Mount Holmes. The skyline at the left is the crest of Purple Mountain. To the west lie the small Twin Buttes. Observe the wide area covered by sinter. Consider the time necessary for its deposition. Think of the depth of the travertine at Mammoth. But this is not lime extracted from sedimentary rocks. It is silica extracted from volcanic rocks.

8.2
At the left a road branches to Firehole Lake, Steady and Great Fountain Geysers.

Those taking this road will re-enter the main highway a mile to the south. There are several outstanding exhibits.

We enter a Lodgepole forest and continue south.

8.3
On the left, a quarter of a mile away, we see the cone of White Dome and the steam rising from Firehole Lake. We may wish that we had taken the branch road.

9.1
We meet the road which returns from Firehole Lake, etc.

9.6 LODGEPOLES 9.6

We continue to the south and presently come again to the Firehole River. Directly opposite is where Excelsior Geyser once threw up an amazing mass of water to a height of 300 feet, hurling rocks and sinter to a great distance. The story of Excelsior is one of historic interest.

10.3
Parking area for Midway Geyser Basin.
Dismount and read the story of Excelsior.
Note the Grand Prismatic Spring.
Before leaving, glance up to the east and note that the old masses of lava are still with us.
The scars on distant hills are evidence of its marvelous thickness.
The river is growing smaller.

13.7
A little side road to the right leads to the Biscuit Basin.

UPPER GEYSER BASIN

The Ranger Naturalists at Old Faithful conduct parties to all places of interest in this the Upper Geyser Basin.

Sapphire Pool boils violently every fifteen minutes. Jewel plays at frequent intervals to a height of thirty feet. Silver Globe has a metallic luster, etc.

See the volcanic masses frowning down on us from the neighboring hills. There is evidently another plateau considerably higher than the one that we are on.

Large orange-colored patches mark the site of warm water seeping from the side of the volcanic hills.

14.2

Stop at Artemisia Geyser and examine also the vents on the opposite side of the road.

14.4

Morning Glory Pool and its highly colored corolla will give a thrill.

14.7 14.7

Cross the Bridge noting Riverside Geyser on the left.

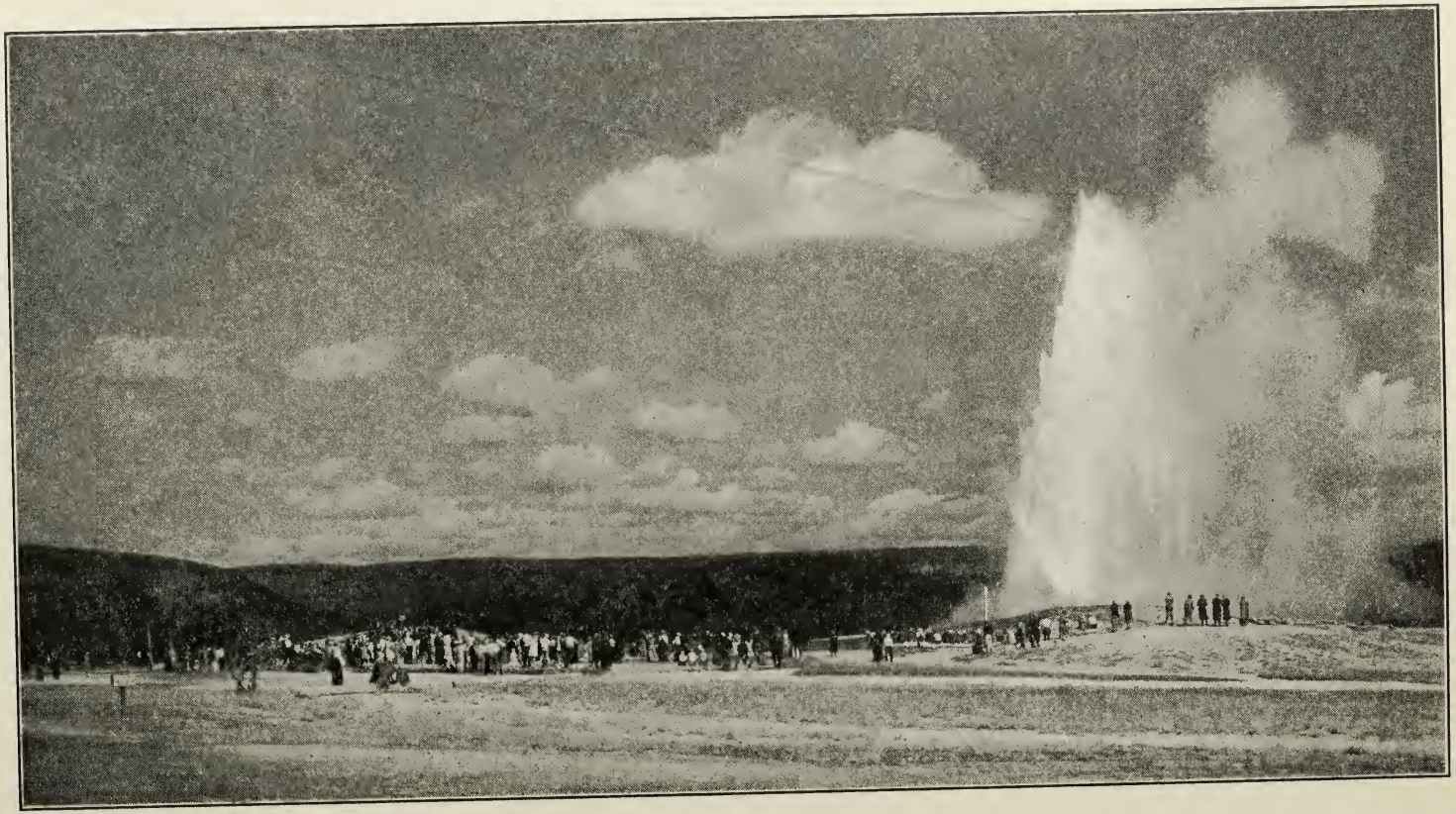
We are about to witness the most famous display of geyser activity in the world.

14.8

Grotto Geyser has a fantastically shaped cone unlike any other in the park.

15.5

We pass Castle Geyser, with its characteristic cone, sweep in front of the famous Inn and come to rest at the parking space, adjoining the Old Faithful Trailside Museum. Here we find a bureau of information, an accommodating staff of ranger naturalists, and an outdoor auditorium where lectures appropriate to Yellowstone are given to the public without charge.



OLD FAITHFUL

GENERALIZED
GEOLOGIC
COLUMN
OF
YELLOWSTONE PARK
or
This column shows the sequence and general character of the rocks in the park. At no one place is the entire section revealed. In former ages erosion carried away much of the older rock layers, and at other places they are concealed beneath volcanic rocks or glacial debris. The total thickness of known rock layers approximates 12,000 feet.~
CENOZOIC
MESOZOIC
PALEOZOIC
PRE-€
QUATERNARY
TERTIARY
CRETACEOUS
TRAVERTINE
TILLITE
TRAVERTINE
BASALT
RHYOLITE
LATE BRECCIA
EARLY FLOWS
EARLY BRECCIA
VOLCANIC ERUPTIVES MAINLY
SEDIMENTARY SHALES AND SANDSTONES
SEDIMENTARY LIMESTONES MAINLY
METAMORPHIC
GRANITE, GNEISS, ETC-

Make Your Recreation Constructive

TAKE ADVANTAGE OF THE

GUIDED TRIPS AFIELD

AND THE

RANGER-NATURALIST

LECTURES

Visit

The Trailside Museums

The National Park Service issues a "Circular of General Information Regarding Yellowstone National Park," which may be procured at Trailside Museums and Ranger Stations in the park.

The Haynes Guide Book of the Yellowstone supplements this information circular and contains more illustrations and fuller historical data. It is edited and approved by the National Park Service and is on sale at all points in the Park at prices approved by the Government.